GRAIN INSPECTION, PACKERS AND STOCKYARDS ADMINISTRATION

Technical Services Division January 2001

Grain Sampling Procedures

Introduction

Characteristics of a grain lot are important in the marketing of grain. Knowledge of various characteristics helps marketers determine quality and negotiate prices for the lots. Some of the characteristics that may be of interest are damaged kernels, moisture, protein, foreign material, and aflatoxin. Knowing exactly what the lot contains is the desired outcome of grain inspection.

The only way to know exactly what a lot contains is to inspect the entire lot. Inspecting the entire lot is usually cost-prohibitive and far more time consuming than the grain market will tolerate. A sample, a small subset of the lot, can be inspected in a timely manner and at a reasonable cost. Unfortunately, the content of a sample can and will deviate from the content of the lot.

No way exists to tell how much a single sample will deviate from the lot content. If a random sample is taken , however, probability theory can describe the likelihood that a sample will deviate by a certain amount from the lot content. A random sample is a sample selected in a process where every possible sample from a lot has an equal chance of being selected.

Unfortunately, a random sample is often not possible in practice. Many applied sampling procedures are devised to obtain a sample that approximates a random sample. The practical sampling procedures often involve the systematic selection of material throughout the lot. The sampling procedures developed by the Grain Inspection, Packers and Stockyards Administration (GIPSA) for sampling grain lots uses this systematic sampling concept.

Representative Sample

The sample selected for an inspection by the GIPSA sampling procedures is called a representative sample. This sample approximates a random sample.

The process for acquiring the representative sample has three stages. The first stage results in the primary sample selected from a lot. A mechanical sampler or a hand probe is used to obtain the primary sample. The primary sample is often much larger than necessary for inspection and will be reduced in a second stage before the sample is taken to the inspection lab.

The second stage results in a secondary sample. With the diverter-type (D/T) sampler, a secondary rotary sampler is built into the sampling system to automatically reduce the primary sample. The hand probe sample is a manual process. The primary sample from a probe sample has to be reduced to a secondary sample with a device called a cargo divider. The primary sample is usually poured through the cargo divider by hand.

The secondary sample is taken to the inspection laboratory where one or more inspection samples may be obtained from the secondary sample.

Primary Sampling Methods

Of all the sampling devices available, the mechanical sampler obtains the most representative sample from lots of grain. They are powered either pneumatically, electrically, or hydraulically. The diverter-type (D/T) mechanical system is used for commodities with large particle size such as whole grain.

Even though D/T's vary in design, all operate on the same principle. Installed at the end of a conveyor belt or within a spout, they draw their sample by periodically moving a pelican (named for its resemblance to the beak of a pelican) through the entire grain stream.

Figure 1. Diverter-Type sampler installed in spout.

The frequency of these "cuts" is regulated by timer controls. After the grain enters the primary sampler, it flows through a tube into a secondary sampler. The secondary sampler reduces the size of the sample. From the secondary sampler, the sample flows to a collection box or sample bucket.

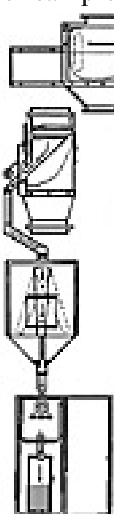

Figure 2. Diverter-type mechanical sampling system used for whole grain.

A large percentage of grain, as it travels from the farm to the final consumer, is sampled with a probe sometimes referred to as a trier. The probe is the only sampling method approved by GIPSA for stationary lots. If probe sampling is performed correctly, the samples drawn are considered representative.

Probes are constructed of brass or aluminum and come in various sizes with standard legnths of 5, 6, 8, 10, and 12 feet. The type of carrier dictates which probe length is used. Probes consist of two tubes, one inside the other.

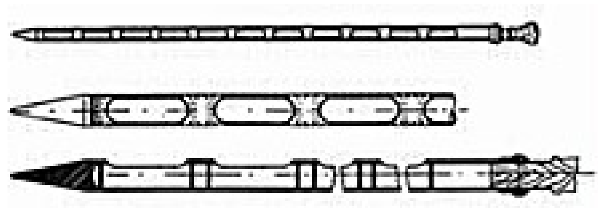

Figure 3. Grain probe or trier

GIPSA approved grain probes are 1 3/8 inches in diameter (outer tube). The inner tube is divided into compartments. The outer tube has slots which match the compartment openings of the inner tube. When the tubes are aligned, grain may enter into or be emptied from the compartments of the probe.

The lengths of double-tube compartmented probes approved by GIPSA for sampling lots of bulk grain can be found in Table 1.

Table 1. GIPSA approved probe sizes for sampling stationary lots of grain.

Carrier	Length (feet)
Flat-bed truck/trailer	5 or 6
Hopper-bottom trailer	6, 8, or 10
Box Car	6
Hopper Car	10 or 12
Barge	12

Mechanical probes, like hand probes, are used to sample stationary lots of grain in trucks and other open top carriers. There are two types of mechanical probes that may be used: the gravity-fill probe and the core probe. A third type, the in-load suction probe, tends to overestimate foreign material and should not be used for trade.

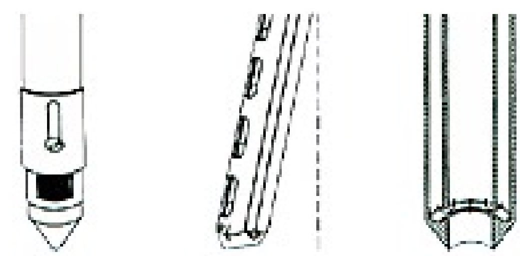

Figure 4. Mechanical Probe Types

Sampling Patterns

GIPSA has established a sampling pattern for each type of carrier. Each lot should be probed in as many additional locations as necessary to assure that the sample is the required size and representative of the lot. Additional probes should be drawn in a balanced manner. For example, one compartment of hopper car should not be probed twice unless the other compartments are also probed twice, regardless of the amount of grain in any one compartment or the amount of additional sample needed.

The following diagrams indicate the standard sampling patterns. Insert the probe at the points marked, with the tip of the probe angled ten degrees in the direction of the arrow. When two arrows are shown, the tip of the probe may be pointed in either of the indicated directions at the samplers discretion.

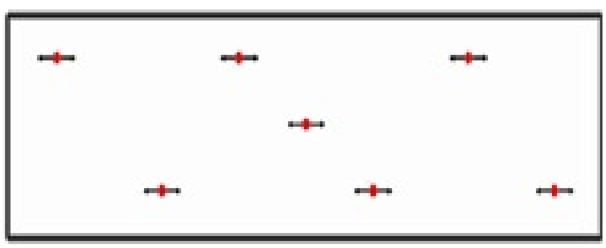

Figure 5. Seven probe pattern for flat-bottom trucks or trailers containing grain more than four feet deep.

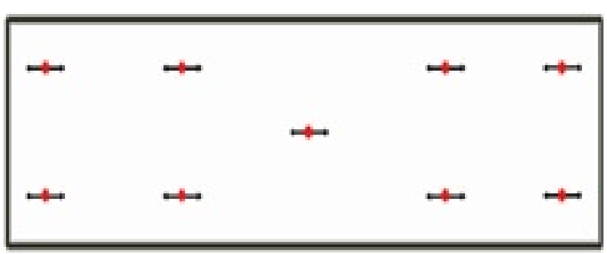

Figure 6. Nine probe pattern for flat-bottom trucks or trailers containing grain less than four feet deep.

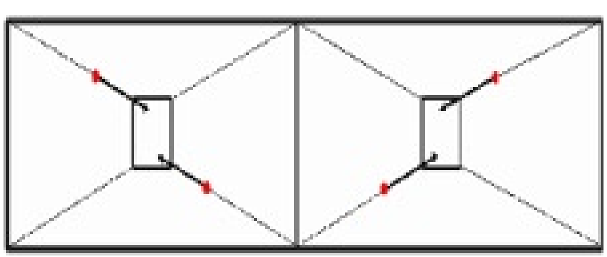

Figure 7. Hopper bottom trailers or containers.

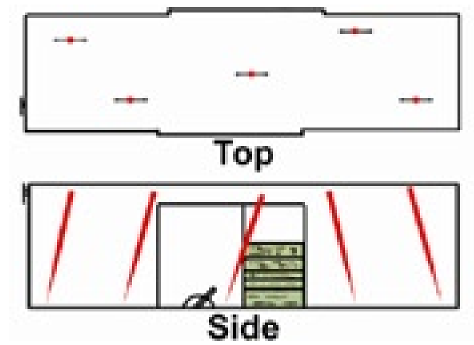

Figure 8. Boxcar

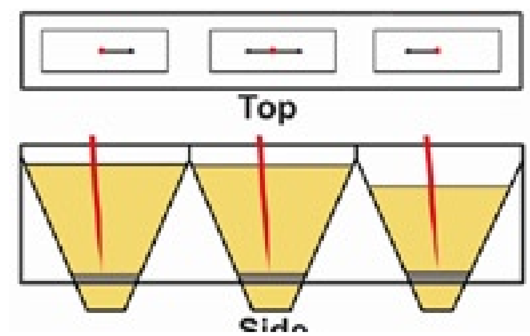

Figure 9. Hopper car

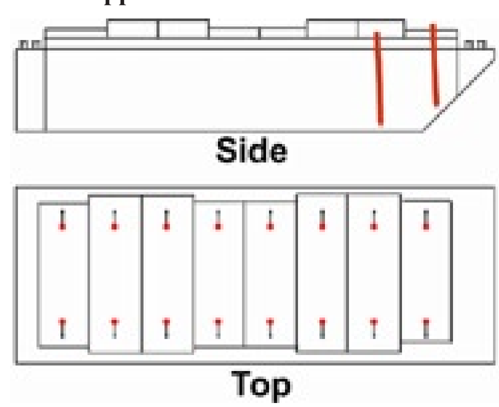

Figure 10. Roll-top barge

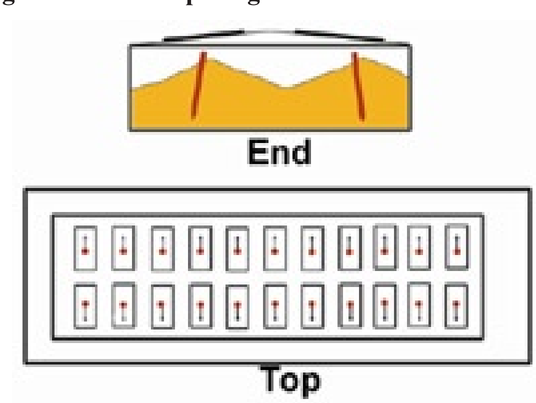

Figure 11. Flat-top barge

Secondary Sampling Methods

Figure 2 shows how a rotary divider is used with a D/T to obtain a secondary sample. An inspector simply goes to the collection box to get the secondary sample in this automated system.

The primary sample with a probe is the composite of all the individual probes in a probe pattern. The primary sample may be considerably larger than the 2000-2400 gm target size of the secondary sample.

A cargo divider is the most common device for reducing the primary probe sample to the secondary sample. The cargo divider is designed to produce a 50-50 split of the sample. Several passes through the cargo divider may be necessary to get to the target secondary sample size. For example, if the primary sample is 9000 gm, the sample can be split into approximately 4500 gm samples and then one of the 4500 gm samples can be split into approximately 2250 gm samples. One of the 2250 gm samples then becomes the secondary sample.

Figure 12. Left: Cargo Divider, Right: Boerner Divider

Inspection Sample

The secondary sample is taken to the inspection laboratory where it is reduced to the appropriate size inspection samples. The Boerner divider is the most widely used laboratory divider for reducing secondary samples to inspection samples.

The Boerner divider, like the cargo divider, is designed to produce a 50-50 split of the sample. To obtain the desired inspection sample size, successive passes through the Boerner divider may be necessary. In some instances, successive reductions and selective recombination may be necessary to obtain the desired inspection sample size.

Sample Size

In general, larger samples will have estimates with less variability than smaller samples. The cost of processing a sample and measuring a characteristic usually increases as the sample size increases. Choosing a sample size is often a compromise between the desire for good precision and the cost of obtaining the measurement.
GIPSA has selected sample sizes for all official measurements. Table 2 gives some examples of official sample sizes. The sample sizes are given in grams.

Typically, the number of kernels in a sample will directly influence the precision of estimates. However, weighing the sample is much faster and less expensive than having an inspector count out the number of kernels. Using average kernel weight, kernel counts are converted to weight to facilitate the acquisition of the inspection sample.

Table 2. Official Sample Sizes For Selected Factors

Factor	Grain	Weight (gm)
Damaged kernels	Corn	250
Damaged kernels	Soybeans	125
Moisture	Wheat	350
Aflatoxin	Corn	4500
Protein	Wheat	500
Splits	Soybean	125